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ABSTRACT

A series of studies was conducted over a three-year period to determine whether the teaching technique developed in the 1960s called "inquiry training" is effective for teaching problem-solving, thinking, and/or decision-making skills. (Inquiry training is a process in which students are provided with a puzzling situation, are given the opportunity to gather information, and are then encouraged to formulate theories explaining the discrepant event.) The first year's study, involving students from grades 3 through 6, resulted in a change in the name of the technique to "cognitive enhancement," the refinement of teaching techniques used, and the development of a list of 19 cognitive enhancement skills. The second year's study involved students from grades 3 through 7 and showed statistically significant growth among students from pretest to posttest, while the third year's study resulted in a refinement of the testing methodology. It was concluded that cognitive enhancement (1) is a potentially highly effective method of teaching cognitive skills, (2) appears to be appropriate for use with elementary level to college level students, and (3) can be used with almost any subject matter. (A chart of subsets of cognition enhancement skills, a diagram of the relationships among sets of subskills, and information on ordering detailed results of each study from the author are included.) (LLZ)

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STUDIES ON THE EFFECTIVENESS OF THE COGNITION ENHANCEMENT TECHNIQUE FOR TEACHING THINKING SKILLS

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CS 008 331

STUDIES ON THE EFFECTIVENESS OF THE COGNITION ENHANCEMENT TECHNIQUE FOR TEACHING THINKING SKILLS

By Donald D. Hansler

During the 1960's, a teaching technique called "Inquiry Training" was developed and promoted by Richard Suchman, formerly on the staff of the University of Illinois. Inquiry Training was shown to be a teaching process which consisted of three primary parts:

A. Students were shown a "discrepant event", a puzzling situation which was intended to arouse curiosity.
B. The students were given an opportunity to gather information about the discrepant event by asking the teacher questions.
C. The students were allowed and encouraged to formulate "theories" explaining the discrepant event.

During about a two-year period, roughly 1965 to 1967, a great amount of excitement about Inquiry Training was generated among school personnel in the Puget Sound region of the state of Washington. Extensive inservice training was conducted throughout the region for teams of teachers and administrators from numerous school districts.

At the time, serving in the capacity of Science Coordinator for Bellevue Public Schools, I had mixed feelings about the technique. It appeared to be an exciting new way to teach; but it also appeared to me that most of the teachers whom I knew to be excited about it were looking upon it as a new way to teach facts and principles, rather than as a way to teach problem-solving skills or thinking skills.

For what appears to be a variety of reasons, interest in Inquiry Training declined rapidly. However, I continued to harbor the feeling that this technique, or something similar to it, could be used to teach thinking skills effectively. Therefore, when time finally became available to me, during the 1982-83 school year, for the pursuit of research on this topic, I conducted a series of four levels of rather informal classroom research at Ardmore Elementary School of the Bellevue Public School system. That research was intended to produce data that could be used as a basis for designing some more-refined, better-controlled subsequent research on the same topic. The four levels of research at Ardmore were labelled Levels I through IV, respectively, and they involved four separate classes of students which were multi-level classes containing students from grades 3 through 6.

The major results of the research at Levels I through IV were as follows:

A. A highly productive series of focuses (discrepant events), and one having a great variety of subject matter, was developed.
B. The teaching techniques were modified extensively and refined.
C. The reaction of the students to the teaching technique was very positive.
D. A test over a set of measurable "thinking skills" was developed and refined on the basis of feedback.
E. The growth of students in respect to the pre-test and post-test scores was "probably statistically significant"; however, no statistical test for significance was applied.
F. The evaluation techniques were refined.
G. The participating teachers felt that the student growth was well worth the time spent in the sessions.

As a result of the research at Levels I through IV, I decided to change the name of the technique to Cognition Enhancement. That was because I had observed that a very definite set of skills, which I now call the Cognition Enhancement

Skills, were being exhibited and improved upon by the students as they participated in one session after another. Also, I felt the desirability of more aggressively pursuing the teaching of those skills (which are a subset of the higher cognitive levels) than had been the case with Inquiry Training. In addition, I felt the need for other changes in the technique - changes which were so extensive as to warrant a change in the name of the technique. However, the three primary parts which were described earlier herein for Inquiry Training were retained in Cognition Enhancement. The technique involves presenting the students with especially interesting problems (focuses) from the desired subject-matter field, and teaching the students how to apply various thinking skills in order to solve those problems. The decision as to which subject-matter field and which problems to use depends upon the specific purposes of the teacher and/or the interests of the specific student group. The student activity which occurs during the technique is largely verbal exchange with the teacher and other students. The students gather information related to the problems which have been presented. They do that primarily by asking questions of the teacher, although they occasionally use additional information-gathering methods such as experiments, library research, interviews, and so forth.

The set of nineteen Cognition Enhancement Skills is listed in Appendix A, which shows three subsets of the skills. The Observable Skills are those which students have been observed to exhibit during cognition enhancement sessions. The Measurable Skills are those which are measured by the various forms of the Test Of Cognition Enhancement Skills which have been developed for use in evaluating the effectiveness of this teaching technique. Appendix B contains a Venn diagram of the interrelationships which I perceive to exist among various groups of skills to which educators sometimes refer. It indicates, among other things, that the Cognition Enhancement Skills are a predominant, basic portion of the other sets of skills.

During the 1983-84 school year, additional research was conducted, using eleven classes of students ranging from third grade to seventh grade. The research was divided into Levels V through VIII, each having a different set of objectives. A summary of the major conclusions drawn from the results of that research is as follows:

A. A reasonable time for completing each item on the Test of Cognition Enhancement Skills was established.
B. Some students who usually don't participate verbally during traditional instructional activities in the classroom did participate in the Cognition Enhancement sessions.
C. Teachers found the use of the newly-designed group approach to Cognition Enhancement to be very appealing.
D. Teachers felt that the time spent on the research series was highly justified by the results.
E. The students who were involved in the testing program as well as the instructional sessions had an overall neutral feeling about the series. But students who had only the instructional sessions had a very positive feeling about the series.
F. Form 1 and Form 2 of the Test of Cognition Enhancement Skills were shown to be statistically equivalent.
G. As measured by the Test of Cognition Enhancement Skills, students who participated in ten 45-minute Cognition Enhancement sessions demonstrated statistically significant growth from pre-test to post-test.
H. The cumulative effects of exposure to multiple instructional sessions did not reach a plateau within the span of thirteen sessions.
I. Students of high ability tended to learn the Cognition Enhancement Skills to a higher degree than did students of lower ability.

J. Students who participated overtly more tended to learn the Cognition Enhancement Skills to a greater degree than did students who didn't participate overtly as much. But there are enough individual major exceptions to this pattern to warrant caution against basing an estimate of an individual student's learning of the Cognition Enhancement Skills on his or her overt participation.
K. The students' application of advanced Cognition Enhancement Skills increased significantly during the series.
L. The length of the participation sequences by individual students increased significantly during the series.
M. Overall, Form 1 and Form 2 of the Test of Cognition Enhancement Skills were shown to have a high level of validity and applicability in this study.

During the 1984-85 school year, another research project was designed and implemented, with the results of the 1983-84 project in mind. With reference to the previous eight levels of research which I had conducted on this topic, the 1984-85 project was designated as Level IX. The general objectives of Level IX were as follows:

1. To determine whether Forms 2 and 3 of the Test of Cognition Enhancement Skills are equivalent.
2. To determine whether students reach a plateau in their scores on the Test of Cognition Enhancement Skills within the span of sixteen instructional sessions.
3. To determine whether students in a group which receives instruction in Cognition Enhancement (experimental group) score significantly higher on the Test of Cognition Enhancement Skills than do students in a group which has received no instruction (control group).

In order to achieve the above three objectives, a complex research schedule involving two experimental groups and two control groups was established. The groups of students who participated in this level were four classes of typical, non-select 5th-graders.

As a result of the 1984-85 research, the following conclusions were reached:

A. Students who demonstrated a higher basic ability, as measured by the Test of Cognitive Skills (TCS), tended to score better on the Test of Cognition Enhancement Skills, whether it was the pre-test prior to instruction or the post-test following instruction, than did students of lower ability. Also, they tended to demonstrate more growth on the test, from pre-test to post-test, than did students of lower ability.
B. Form 2 and Form 3 of the Test of Cognition Enhancement Skills were shown to be equivalent.
C. Multiple exposure to a specific form of the Test of Cognition Enhancement Skills , in and of itself, resulted in slightly elevated test scores.
D. Students who received sixteen instructional sessions in Cognition Enhancement attained post-test scores which were higher than those of students who received no instruction, and the difference was statistically significant.
E. As measured by the Test of Cognition Enhancement Skills, the growth of students in the Cognition Enhancement program did not reach a plateau within the span of sixteen instructional sessions.

The three years of research tend to support my view that Cognition Enhancement is a potentially highly-effective method of teaching a set of skills which is intertwined extensively with thinking-skills, problem-solving skills, and

decision-making skills. As the basis for a special course to be offered in isolation from other classes of the curriculum, it appears to be appropriate for use with students from elementary school level to college level. If integrated with other classes, it is probably most appropriate for use at the elementary level, or in conjunction with science, social studies, language arts, and mathematics classes at higher levels. But there are indications that it can be integrated with almost any subject-matter area. Although its primary use is for teaching the Cognition Enhancement Skills, an important side-benefit is that the students might also learn some significant principles from the subject-matter field which is used as the vehicle.

Three separate, detailed reports on the results of the research conducted during the 1982-83, 1983-84, and 1984-85 school years, respectively, are available to anyone wanting to examine them. For copies, write to: Don Hansler, 20315 SE 39th St., Issaquah, WA 98027. Indicate the year or years for which you want the reports, and include a check for $3.00 for each report desired, in order to cover printing and mailing costs.

SUBSETS OF COGNITION ENHANCEMENT SKILLS

General Skills	Observable Skills (As observed in Cognition Enhancement sessions.)	Measurable Skills (As measured by the pre-test and post-test)
1. Is able to formulate a hypothesis which attempts to explain a specific phenomenon.	1. States hypotheses.	1a. From a list of hypotheses attempting to explain a specific phenomenon, selects the only one which could be reliable. (1,2)* 1b. Given a hypothesis, selects, from a list of data, the one item that warrants formulation of the hypothesis. (3)
2. Is able to gather data that verify conditions, objects, and other factors involved in a specific phenomenon.	2. Asks verification questions.	2. From a set of questions, selects the one which best verifies a condition. (4)
3. Is able to conduct experiments which yield data related to a specific phenomenon.	3. Asks experimentation questions.	3a. From a set of questions, selects the one which corresponds most closely to conducting an experiment. (5) 3b. From a set of questions, selects the best re-wording of a given unacceptable experimentation question. (6)
4. When confronted by the need to know whether a specific factor is vital to the existence of a specific phenomenon, is able to gather data that lead to a conclusion in that regard.	4. Re-words synthesis or necessity questions into an acceptable form.	4 & 5. From a set of questions, identifies all which ask about the reliability of a hypothesis. (7)
5. Realizes that conclusions must be based on data rather than speculation.	5. Avoids synthesis and necessity questions.	
6. Is able to use data-gathering processes that focus on the specific type of data desired.	6. Words questions precisely.	6. From a set of questions on the same topic, selects the most precise wording as being the best wording. (8)
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7. Realizes that a specific factor which is present to a certain degree in one of a pair of phenomena being compared is not necessarily significant unless that same factor is present to a <u>different</u> degree in the other one of the pair.	7. Asks control questions.	7. From a list of possible next questions, selects the control question as being the logical next question. (9)
8. Is able to build upon data already gathered.	8. Asks sequential series of questions.	8a. From a set of questions, selects the one which should be asked first in a series. (10) 8b. Arranges a given set of questions in the order in which it would be best to ask them. (17)
9, 10, & 11. Is able to use data previously gathered by self or others, in order to either formulate hypotheses or gather additional data.	9. Uses data gathered by self as a basis for unique hypotheses. 10. Builds on data gathered by other students. 11. Uses data gathered by others as a basis for unique hypotheses.	9, 10, & 11. Given a set of data, selects from a list of hypotheses the one hypothesis which best fits the set of data. (14, 15)
12. Is able to formulate a hypothesis in such a manner that it fits all of the data.	12. States hypotheses precisely.	12. From a list of possible hypotheses, selects the most precise hypothesis. (15)
13. Is able to identify data that confirm hypotheses.	13. Points out data that confirm hypotheses.	13a. From a list of data, selects the item of data that best leads to a hypothesis. (3) 13b. From a list of data, selects the item of data that does not support a given hypothesis. (11)
14. Is able to identify data that show a hypothesis to be unreliable.	14. Points out data that invalidate hypotheses.	14 & 15. Given a hypothesis, identifies, from a list of data, those which indicate the hypothesis to be unreliable. (12, 13)
15. Is willing to reject own hypothesis when valid data indicate that it is unreliable.	15. Rejects own hypotheses when invalidating evidence is apparent.	
9		10

16. Is able to realize the need for changes in hypotheses when new data warrant them, and is able to modify the hypotheses accordingly.	16. Suggests changes in hypotheses on the basis of new data that have been gathered.	16. Given a set of new data, selects, from a list of hypotheses, the modified hypothesis which best reflects the new data. (16)
17. Is able to identify a hypothesis as not having been tested adequately.	17. Points out untested hypotheses.	17. Given a set of data, selects, from a list of hypotheses, the hypothesis which is not tested by the data. (18)
18. Is able to recognize and value more specific hypotheses, as opposed to less specific hypotheses.	18. Points out and values greater specificity levels among hypotheses.	18. From a list of reliable hypotheses, selects the most specific hypothesis fitting a given set of data. (15)
19. Is able to gather data under a variety of conditions and in a variety of ways.	19. Tests hypotheses by gathering data independently.	(There is no test item corresponding to this observable skill.)

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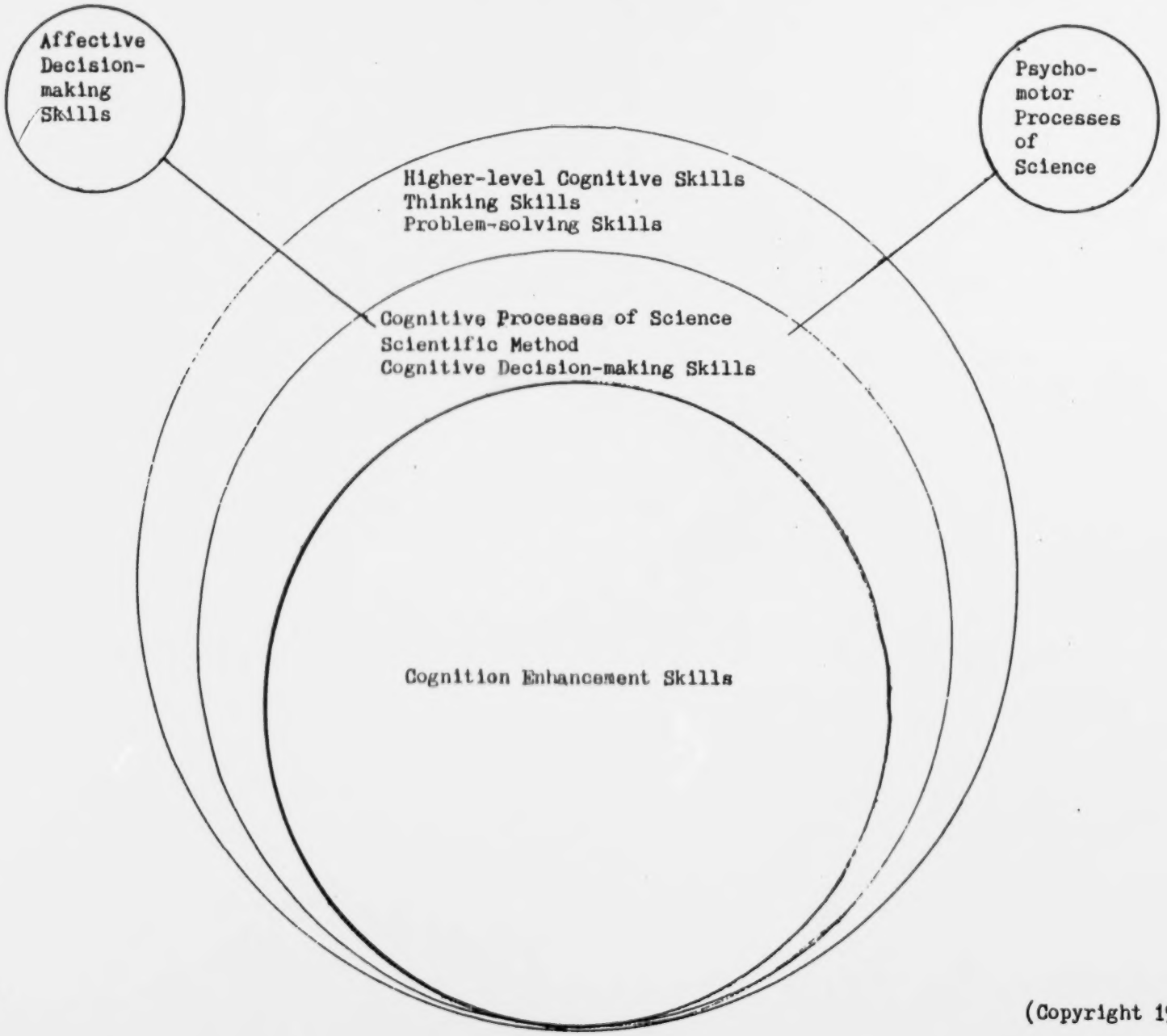
VENN DIAGRAM OF THE INTERRELATIONSHIPS BETWEEN VARIOUS SETS OF SKILLS



Appendix B

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